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**NEW UTILITY PATENT APPLICATION  
TRANSMITTAL  
(Small Entity)**

*(Only for new nonprovisional applications under 37 C.F.R. 1.53(b))*

Docket No. H01.2-9276

Total Pages in this Submission  
(including checks and postcard)

75

1c682 U.S. PTO  
09/668866

09/25/00

Box Patent Application  
Assistant Commissioner for Patents  
Washington, D.C. 20231

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled: Apparatus for Removing Semiconductor Wafers From Within The Runner Disks of a Double-Sided Polishing Machine.

and invented by: Eberhard Potempka

If a CONTINUATION APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: \_\_\_\_

Enclosed (in addition to the 4 pages of this transmittal) are:

4 pages

**Application Elements**

1. ☒ **Filing fee as calculated below:**  
a ☒ filing fee is NOT ENCLOSED - fee will be paid at the time of responding to Notice of Missing Parts - DO NOT CHARGE DEPOSIT ACCOUNT  
b. ☐ a check in the amount of \$ \_345.00 to cover the filing fee is enclosed.  
c. ☐ charged to Deposit Account as authorized in item 2(a) below \_1pages

FEE CALCULATION AND C L A I M S					
For	No. Filed	No. Allowed	No. Extra	Rate	Fee
Total Claims	20	20 - =		x \$9.00	\$
Indep. Claims	1	3 - =		x \$39.00	\$
BASIC FEE					\$ 345.00
TOTAL FILING FEE					\$ 345 <sup>00</sup>

continued on next page.....

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2. The Commissioner is hereby authorized to charge and credit Deposit Account No. 22-0350 as described below. A duplicate copy of this sheet is enclosed. \_\_\_\_\_ page
- ☐ Charge the amount of \$\_\_\_\_ as filing fee.
  - ☒ Credit any overpayment.
  - ☒ Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
  - ☐ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).
3. ☒ Specification having 15 pages and including the following: 15 pages
- ☒ Application Cover Sheet - 1 page
  - ☒ Descriptive Title of the Invention
  - ☐ Cross References to Related Applications (*if applicable*)
  - ☐ Statement Regarding Federally-sponsored Research/Development (*if applicable*)
  - ☐ Reference to Microfiche Appendix (*if applicable*)
  - ☒ Background of the Invention
  - ☒ Brief Summary of the Invention
  - ☒ Brief Description of the Drawings (*if applicable*)
  - ☒ Detailed Description
  - ☒ Claim(s) as Classified Below - 2 pages
  - ☒ Abstract of the Disclosure - 1 page
4. ☒ Drawing(s) (*when necessary as prescribed by 35 U.S.C. 113*) - 4 sheets 4 pages
5. ☒ Oath or Declaration \_\_\_\_\_ pages
- ☒ Newly executed (*original or copy*) ☐ Unexecuted
  - ☐ Copy from a prior application (37 C.F.R. 1.63(d)) (*for continuation/divisional appln only*)
6. ☒ Separate Power of attorney 1 pages
- ☒ 37 C.F.R. 3.73(B) Statement (*when there is an assignee and power of attorney is from assignee*). It is hereby certified that the undersigned has authority to make this certification and has reviewed all the documents in the chain of title of the patent application identified herein and, to the best of undersigned's knowledge and belief, title is in the assignee identified in the accompanying Power of Attorney.

<b>NEW UTILITY PATENT APPLICATION TRANSMITTAL (Small Entity)</b> <i>(Only for new nonprovisional applications under 37 C.F.R. 1.53(b))</i>	Docket No. H01.2-9276
	Total Pages in this Submission (including checks and postcard) <div style="text-align: right;">75</div>

7. Incorporation by Reference *(usable if Box 5b is checked)*  
 The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 5b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
8. ☒ Verified Statement(s) Claiming Small Entity Status \_1\_ pages
- a. ☐ Independent Inventor
- b. ☒ Small Business Concern ("Assignee")
- c. ☐ Non-Profit Organization
- d. ☐ Non-Inventor Supporting Claim by Another
- e. ☐ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.
9. ☐ Computer Program in Microfiche *(Appendix)* \_\_\_ pages
10. ☐ Nucleotide and/or Amino Acid Sequence Submission \_\_\_ pages  
*(if applicable, all must be included)*
- a. ☐ Paper Copy
- b. ☐ Computer Readable Copy *(identical to computer copy)*
- c. ☐ Statement Verifying Identical Paper and Computer Readable Copy

### Accompanying Application Parts

11. ☒ Assignment Papers: \_3\_ pages
- a. ☒ Assignment Recordation Cover Sheet (Form PTO 1595)
- b. ☒ Assignment
- c. ☒ A check in the amount of \$ 40 to cover the Recordal Fee
- d. ☐ Previously recorded on \_\_\_\_\_, Reel \*, Frame \*.
12. ☐ English Translation Document *(if applicable)* \_\_\_ pages
13. ☐ Information Disclosure Statement: \_\_\_ pages
- a. ☐ PTO Form 1449      b. ☐ Copies of IDS Citations
14. ☐ Preliminary Amendment \_\_\_ pages  
 The fee calculation below is based on the claims after the preliminary amendment.

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15. ☒ Acknowledgement Postcard - 1 page
16. ☒ Form of Mailing - Express Mail (*Specify Label No.*): EL599955906US
17. ☒ 2 -Certified Copy of Priority Document(s) (*if foreign priority is claimed*) 43 pages
18. ☒ Additional Enclosures (*please identify below*): 2 pages
- ☒ Constructive Petition for Extension of Time and Fee Authorization Pursuant to 37 C.F.R. §1.136(a)(3)
  - ☒ Correspondence Address form
  - ☐ \_\_\_\_\_

Respectfully submitted,

VIDAS, ARRETT & STEINKRAUS

Date: 9-25-2000

By:



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## PATENT/DESIGN PATENT

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor: Eberhard Potempka )  
 Title: APPARATUS FOR REMOVING SEMICONDUCTOR )  
 WAFERS FROM WITHIN THE RUNNER DISKS )  
 OF A DOUBLE-SIDED POLISHING MACHINE )  
 Filed: [X] Concurrently herewith )  
 [ ] on \_\_\_\_\_ )  
 Ser. No. \_\_\_\_\_ )

**VERIFIED STATEMENT  
 CLAIMING  
 SMALL ENTITY STATUS**

(ASSIGNEE FORM)

Docket No. 401.2-9276

As a representative of the below named company I hereby state that:

1. I am empowered to act on behalf of the Company in making the following statements to establish status as a small entity under 37 C.F.R. § 1.9.

2. By assignment of all right, title and interest in and to the invention described above, the Company is the owner of the subject matter of a patent application identified above, the docket no., filing date and application number of which application may be inserted above by any attorney of Vidas, Arrett & Steinkraus, P.A., when known.

3. The company has not assigned, granted, conveyed or licensed any rights in and to the invention, and is not under any obligation, contract or law to assign, grant, convey or license any rights to said invention to any other party.

4. The Company is a business concern which presently employs less than 500 persons.

5. Based upon the above facts, it is believed that the Company is a Small Business for paying reduced fees as set forth in 37 C.F.R. §1.9(d).

6. The company acknowledges its duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate (37 C.F.R. §1.28(b)).

7. The Company hereby declares that all statements made herein of its own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Peter Wolters Werkzeugmaschinen GmbH  
 Company name

Büsumer Strasse 96, D-24769 Rendsburg/Germany  
 Company address

Dated. 10. May 2000

By Bauer  
Dr. Carl-Ulrich Bauer

Title Managing Director

(Filing date, serial number and docket number may be left blank at time of signing)

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**APPARATUS FOR REMOVING SEMICONDUCTOR WAFERS  
FROM WITHIN THE RUNNER DISKS OF A  
DOUBLE-SIDED POLISHING MACHINE**

5 CROSS-REFERENCE TO RELATED APPLICATIONS

Not Applicable

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

Not Applicable

10

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for removing semiconductor wafers from within the runner disks of a double-sided polishing machine.

15 It is known to work semiconductor slices or wafers (SC wafers) by means of polishing machines in such a way that a high degree of smoothness, non-defectiveness, and fineness of the surface is obtained. Such a double-sided polishing machine has become known from DE 195 47 086. Runner disks having three apertures, for example, to receive SC wafers interact with an  
20 outer and an inner pinned rim and are rotationally advanced if at least one of the pinned rims is driven. This causes the SC wafers to perform a cycloidal motion which is overlain by the rotation of the working disks. Thus, it is possible to machine parallel-sided surfaces on work pieces at a high accuracy.

25

The known machine also makes it possible to position the runner disks for the loading or unloading of the SC wafers. While this does not apply to the circumference of the runner disks it does apply to the center thereof. Hence, it is possible to stop the center of a runner disk at a predetermined point, using the drive of at least one pinned rim.

30

The runner disks have been fed and unloaded again by hand hitherto. Any manual

handling of a freshly polished SC wafer involves the risk that its polished surface might be damaged, e.g. by producing marks or scratches. Particularly critical are those damages which cover the front side of the SC wafer. Also, freshly polished SC wafers are extremely sensitive to non-controlled attack by chemicals such as an etching agent. As is known the polishing of such SC wafers using the machine described is a mechanical and chemical process. Any further chemical impact of the polishing agent is detrimental upon completion of the polishing process and, therefore, requires to be stopped as rapidly as possible, e.g. by transferring the SC wafer to a rinsing, neutralizing or cleaning bath.

Since the double-sided polishing operation on SC wafers as described is a so-called batch process a large number of SC wafers needs to be removed as rapidly as possible upon completion of the process.

It is the object of the invention to provide a device for removing SC wafers from within the runner disks in a double-sided polishing machine in which the SC wafers may be rapidly removed and deposited in an automatic manner with no manual step. Furthermore, the SC disks are intended to be removed in a desired order.

## BRIEF SUMMARY OF THE INVENTION

The inventive device provides a suction head which may be connected to a vacuum and, in one aspect of the invention, may have one or more suction cups. These suction ports or suction cups are designed so that all of the SC wafers of a runner disk can be gripped and raised simultaneously. The suction head is adapted to be rotated by means of a rotary drive for an alignment towards the SC wafers lying in a runner disk. The suction head, after being swiveled to a lay-down device, may be adjusted again in a predetermined aligned position towards the lay-down device.

The suction head is rotatably supported on an arm, preferably a swivel arm which, in turn,

is rotatably or adjustably supported about a vertical axis. In addition, the arm is adjustable in height by means of a lifting drive. A control device is provided for the individual drives to control the position of the arm and the suction head above a runner disk and the lay-down device.

5 As was already mentioned at the beginning the polishing machine is capable of precisely controlling the runner disks in their position between the pinned rims. Therefore, it is possible to precisely position each runner disk with respect to the removing apparatus. Hence, it is readily possible as well to use the control device for moving the arm to a position in which the axis of rotation of the suction head is aligned towards the center of a runner disk. Rotating the suction  
10 head will then make it possible to associate the suction ports and suction cups with the SC wafers received in the runner disk. In one aspect of the invention, this can be accomplished by the fact that a mark, e.g. a bore, is associated with a reception aperture of the runner disk and the suction head has a sensor for detecting the mark.

It is desirable and even prescribed frequently to take the SC wafers out of the polishing machine in the order in which they were inserted. For example, if the first SC wafer is placed by hand or machine in that reception aperture of the runner disk to which the mentioned marking belongs and further insertion is effected in a predetermined sense of rotation it will also be possible to deposit the SC wafers on a lay-down device in a predetermined orientation so that  
20 they may be conveyed, for example, to a reception cassette in the same direction as the one while they were loaded from the lay-down device.

In another aspect of the invention, the lay-down device has a circular plate adapted to be driven by a rotary drive which is subdivided into three sectors wherein each sector has at least  
25 one nest to receive a semiconductor wafer and is supported so as to be tiltable about a horizontal axis and one sector each is adapted to be aligned towards a transfer portion leading to a cassette. When a sector is tipped with an SC wafer received therein this one will slide, for example, on a film of a conveying liquid, to a reception cassette. Such a device has been known as such. The receiving circular plate is already in a liquid bath so that scratches or other harms to the surface



are avoided during the conveyance described.

Preferably, the suction head has two suction cups for each SC wafer being removed, which cups lie on a radius of the SC wafer when the suction head is aligned towards the SC wafers. Preferably, a suction head will then lie aligned towards the center of the SC wafer.

Immersion baths are provided for the suction cups in the nests of the lay-down device and the lay-down circular plate. This allows to keep the suction heads wet and to rinse them during a break.

One aspect of the invention provides that the arm is pivotally supported about a vertical axis in a bearing component and is driven by a semirotary drive and that the bearing component is movably supported along a linear guide which is arranged between the polishing machine and another polishing machine where the bearing component is adapted to be displaced by an actuator drive along the guide. In this aspect of the invention, the unloading apparatus is capable of alternatively being employed on one of two polishing machines disposed next to each other by means of a linear transfer device. The mode of operation allows for two different options. First, the inventive unloading apparatus is able to effect the removal of wafers from within two double-sided polishing machines (single-stage process). The rate of process time in the unloading time is about 5 %. Therefore, the unloading apparatus is preponderantly in a stop position. If two machines are linked by the inventive unloading apparatus the cost per SC wafer removed will be correspondingly lower. Furthermore, some mounting area and, possibly, an operator will be saved. One operator is required for each plant in case of two individual plants. In the inventive unloading apparatus, one operator may attend to two plants by using one unloading apparatus.

The inventive unloading apparatus may also be employed for a two-stage process in case of two double-sided polishing machines. At this point, the SC wafers, after undergoing machining, are transferred by means of the unloading apparatus from a first machine to the second machine which effects finishing. After finishing, the removing or unloading apparatus

may deposit the SC wafers in the wet stockpiler.

It is known to support the upper polishing plate in a swivel-away position with respect to the lower one in order that there be a free access to the runner disks and SC wafers. If two double-sided polishing machines are disposed next to each other when the inventive unloading apparatus is used it is useful, therefore, to design the individual machines in such a way that the upper polishing plate be always swivelled away in a direction opposed to the polishing plate of the other machine in order that the machines may be juxtaposed very close to each other.

## BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The invention will now be explained in greater detail with reference to an embodiment shown in the drawings.

Fig. 1 shows a plan view of a polishing machine with the upper working disk swiveled away and having a removing device according to the invention;

Fig. 2 shows a section through the right-hand half of the polishing machine of Fig. 1 and through the removing apparatus;

Fig. 3 shows a plan view of another embodiment of a lay-down device for the removing apparatus of Figs. 1 and 2, and

Fig. 4 shows a plan view of two polishing machines with the upper polishing plates swivelled away and having a removing apparatus in another aspect of the invention for the two polishing machines.

## DETAILED DESCRIPTION OF THE INVENTION

While this invention may be embodied in many different forms, there are described in detail herein a specific preferred embodiment of the invention. This description is an exemplification of the principles of the invention and is not intended to limit the invention to the particular embodiment illustrated.

Referring to the Figures, 10 designates a machine frame of a double-sided polishing machine as has become known, for example, from DE 195 47 086. It has a lower working disk 12 which is rotatably supported in the machine frame and is adapted to be driven from a suitable drive which is not shown in detail. An upper working disk is pivotally supported on an arm 14 which is shown as partially having been swivelled away in a clockwise sense in Fig. 1. The upper working disk cannot be seen because of a cover 18. The arm 14 can be rotated about an axis of rotation 16 and is operated by a semirotary drive which is not shown either.

The lower working disk 12 is of an annular type. It is surrounded by an outer pinned rim 20, and an inner pinned rim 22 is inside the ring. One or either of the two pinned rims 20, 22 may be rotationally driven. Five runner disks 24, which are provided with outer teeth so as to be in engagement with the outer and inner annular rims 20, 22, are arranged in the annular region between the inner and outer pinned rims 22, 20. When the toothed rims are rotated the runner disks are rotated as well while being advanced at the same time. This has been known for such working machines, also especially for polishing machines, for example, from DE 195 47 086 which was mentioned above. The working disks are covered by a polishing cloth, and polishing liquid is fed during the polishing process.

Each runner disk 24 has three reception bores spaced at  $120^\circ$  to receive a semiconductor wafer 26 as is also known as such. Fig. 1 presupposes that each of the five runner disks 24 is loaded with three SC wafers each which have been machined before and are now intended to be gradually unloaded. This is accomplished with the aid of an unloading apparatus which will now

be described in detail. A bracket 28 is mounted on the machine frame 20. It carries a motor 30 with a gearbox 32 and a pinion shaft 34. A special bearing 36 having inner teeth constitutes a rotational connection to a lifting unit 38. The lifting unit 38 may be pivoted about a vertical axis by means of the motor 30. It is understood that the pivoting motion may also be substituted for by a linear motion. The lifting unit 38 has a carrier component 40 which holds a motor 42 and has a linear guide 44 for a carriage 46. The carriage 46 is coupled to a motor 42 via a screw drive 48, which is not described or illustrated in detail, in order that a lifting motion at minimal increments may be performed in a freely programmable manner. The carriage 46 holds a swivel arm 50 on which a motor 52' shown in dotted lines is arranged. The swivel arm 50 has rotatably supported at the free end a suction head 52 about a vertical axis 54. In addition, it may be rotationally driven by a motor 52 via a belt 56 which couples a driven wheel of the motor 52' to a wheel on the head 52. As can be seen from Fig. 1 the head 52 has three arms 58 disposed at spacings of 120°. Each arm has two suction cups 60, 61 which lie on the radius of a SC wafer 26 when the axis 54 is aligned towards the center of a runner disk 24 and the arms 58, in turn, are aligned towards the SC wafers 26. As is apparent from Fig. 2 the suction cups 60, 61 are connected to a vacuum source not shown in detail via appropriate lines 62.

Each runner disk 24 has a bore 64 which is associated with a reception aperture. While the polishing machine is loaded the SC wafers being processed are manually inserted in a way that the reception aperture associated with the bore 64 is loaded first and the remaining reception apertures are loaded subsequently in a predetermined sense of rotation. This loading operation then continues for each runner disk 24 in the same manner.

An arm 58 of the suction head 20 has a lateral arm 68 on which a sensor 70 is mounted. As is apparent from Fig. 2 it projects downwards like a pin and is situated slightly above the plane of the lower ends of the suction heads 60, 61. The sensor 70 helps in detecting the bore 64 of a runner disk 24 in order that the suction head be moved to a desired rotational position at a place above a runner disk with the arms 58 being appropriately arranged with respect to the SC wafers 26.

A lay-down device 72 is shown on the right-hand side next to the machine frame 20 in Fig. 1. It has a lay-down circular plate 74 which is adapted to be indexed in steps of  $120^\circ$  by means of a rotary drive which is not shown in detail. The circular plate 74 has three segments 76 each of which has a nest 78 to receive an SC wafer. Arranged in each of the nests 78 and lying on a radius are two immersion baths 80 for the suction cups 60, 61 of the suction head 52. More reference thereto will be made farther below. Each sector 76 may be tilted about a horizontal axis by means of a displacing device which is not shown in detail.

Each sector 76 may be aligned towards a chute 82 which is flowed over by a liquid film which is fed through slotted apertures 84. Such a device is known as such. The chute conveys SC wafers received to a cassette 86 which is adjustable in height and is supported in the frame not shown in detail of the lay-down device 72 in order to gradually receive the incoming SC wafers. The entire lay-down device is in a cleaning and neutralization bath.

As is outlined at 88 and 90, the transfer device leading from the lay-down circular plate 74 to the cassettes may also be positioned in another arrangement.

The way of action of the device described will now be explained.

The runner disks 24, when in the final phase of the polishing process, are positioned by means of a device as has become known from DE 195 47 086, namely in a way that the runner disk which was loaded first, e.g. runner disk 26, will be stopped below the swivel arm 50 with the SC wafers 1, 2, and 3 being in the desired position. While the position of the reception bores of the runner disk and, hence, the position of the SC wafers 26 is unknown the position of the center of the runner disk 24 is known. When this positioning applies the upper working disk can have been swivelled away already or can be swiveled away as is shown in Fig. 1. Once the positioning of the first runner disk is completed the swivel arm 50, along with the suction head 52, will be swivelled above the runner disk 24 with the axis of rotation 54 being aligned with the center of the runner disk. Subsequently, the suction head 52 is rotated by means of an appropriate

localizing device until the sensor 70 has been aligned with the bore 64 of the runner disk.

Because if the runner disks are loaded manually that aperture of the runner disk which is closest to the bore 64 will always be loaded initially the control unit "knows" which SC wafer to unload first. This is of significance for the lay-down operation later. After the suction head 52 is aligned

5 a vacuum is applied to the suction cups 60, 61 and all SC wafers 26 of a runner disk may be raised simultaneously and may be positioned above the lay-down circular plate 74 by means of the swivel arm 50. During this swiveling motion, the suction head 52 is turned, by means of the aforementioned rotational drive motor 52a, to its neutral position. In this position, that SC wafer 26 which is intended to be removed initially will be opposite the chute 82. Subsequently, the SC  
10 wafers are deposited in the nests 78 of the circular plate 74 by lowering the arm 50 and eliminating the vacuum. Tilting the first sector may then cause the first SC wafer to migrate to the cassette 86 via the chute 86. Subsequently, the rotary drive which is not shown will rotate the circular plate 74 through 120° so that the No. 2 SC wafer is aligned towards the chute 82. Finally, the No. 3 SC wafer will be removed in the same manner.

The rotary drive of the machine has meanwhile positioned the next runner disk 74 in der manner described and unloading is effected again in the manner described. Thus, the SC wafers may be unloaded in a speedy manner and in the order in which the machine also was loaded.

20 The suction cups 60, 61 may be lowered into immersion baths 80 of the circular plate 74 during a break in order to be kept wet and undergo rinsing.

The polishing machine illustrated in Figures 1 and 2 serves for machining SC wafers 12 inches in diameter. However, it is also possible to work smaller SC wafers the diameter of which  
25 is 8 inches, for instance, on such machines. In this case, the runner disks will have 6 reception apertures and the suction head 52 is provided with six arms having suction cups for raising six SC wafers at a time in a runner disk. The lay-down circular plate for the lay-down device, however, is shaped in a way similar to that of Fig. 2. A sketch thereof is shown in Fig. 3.

The lay-down circular plate 74a of the lay-down device 72a as shown in Fig. 3 also has three sectors 76a. Each sector 76a has two lay-down nests 94, 98 to receive SC wafers. For the rest, the sectors 76a are adapted to be tilted about a horizontal axis as are the corresponding sectors 76 of Fig. 1 and the lay-down circular table 74a may be indexed in steps of 120° in order to align one sector 74a each towards a transfer line 98 leading to a station 100 in which a cassette is arranged so as to be adjustable in height (which is not shown in detail). Unlike the transfer line of Fig. 1, the transfer line 98 has two different planes to simultaneously convey SC wafers from the two nests 94, 98 to the cassette. Like the nests 78 of Fig. 1, the nests 94, 98 may be provided with immersion baths for the suction cups of the suction head.

In the embodiment of Fig. 4, two double-sided polishing machines are disposed next to each other. The left-hand one is identical to the double-sided polishing machine of Fig. 1. Likewise, the lay-down device (wet-type feeder) is identical to that of Fig. 1. In addition, the right-hand side of Fig. 4 shows another double-sided polishing machine the structure of which is identical to that of the double-sided polishing machine shown on the left except that its upper polishing disk (which cannot be seen either) is adapted to be pivoted in an anticlockwise sense when swiveled away from the lower working disk 12a, in contrast to the left-hand machine in which the upper polishing disk is pivoted in a clockwise sense. For the rest, the reference numbers of the left-hand machine are equal to those of the machine of Fig. 1 and the right-hand machine of Fig. 4 also has the same reference numbers to which an index a is added.

In Fig. 4, the bracket which pivotally supports the swivel arm 50 about a vertical axis to make it adjustable in height and which is indicated by 28 in Fig. 2 may be displaced along a linear guide 100 between the machines in a horizontal direction along the double arrow 102. This purpose is served by an actuator drive which is not shown. Thus, the unloading apparatus 50 may be used in optionally operating the left-hand and the right-hand polishing machine. Fig. 4 depicts the operation of the right-hand polishing machine from the unloading apparatus with the unloading apparatus 50 being shown in dotted lines. Hence, semiconductor wafers may be deposited in the lay-down device 72 from both the one and other machine. It is also possible to

transfer the semiconductor wafers from one machine to the other machine if a so-called two-stage process is carried out.

The above Examples and disclosure are intended to be illustrative and not exhaustive.

These examples and description will suggest many variations and alternatives to one of ordinary skill in this art. All these alternatives and variations are intended to be included within the scope of the attached claims. Those familiar with the art may recognize other equivalents to the specific embodiments described herein which equivalents are also intended to be encompassed by the claims attached hereto.



What is claimed is:

1. An apparatus for removing semiconductor wafers from within the runner disks in a double-sided polishing machine, comprising:

a suction head (52) adapted to be connected to a vacuum, which has a plurality of suction ports (60, 61) such that all semiconductor wafers (26) received by a runner disk (24) may be gripped simultaneously;

an arm (50) on which the suction head (52) is rotatably supported about a vertical axis and which, in turn, is pivotally supported about a vertical axis at a spacing from the suction head or is supported so as to be linearly adjustable or adjustable in height;

a rotary drive (52') for the suction head (52), a drive (30) for the arm (52), a lifting drive for the arm (52), and

a control device for activating the drives such that the semiconductor wafers (26) may be deposited on a lay-down device (74) in a predetermined, aligned position.

2. The apparatus according to claim 1, characterized in that the runner disks (24) have a mark (64), the suction head (52) has a sensor (70) for detecting the mark (64) and the control device, while rotating the suction head (52), moves it to a predetermined rotational position relative to the runner disk (24).

3. The apparatus according to claim 1, characterized in that the mark (64) is a deepened point, especially a bore.

4. The apparatus according to claim 1, characterized in that the suction head (52) has two suction cups (60, 61) for each semiconductor wafer (26) which lie on a radius of the semiconductor wafer (26) when the suction head (52) is aligned towards a runner disk (24).

5. The apparatus according to claim 4, characterized in that one suction cup (61) is aligned towards the centre of the respective semiconductor wafer (26).

6. The apparatus according to claim 1, characterized in that the lay-down device (72) has a circular plate (74) adapted to be driven by a rotary drive which is subdivided into three sectors (76, 76a) wherein each sector (76, 76a) has at least one nest (78, 78a) to receive a semiconductor wafer and is supported so as to be tiltable about a horizontal axis and one sector (76, 76a) each is adapted to be aligned towards a transfer portion (82, 98) leading to a cassette.

7. The apparatus according to claim 1, characterized in that immersion baths (80) for the suction cups (60, 61) of the suction head (52) are arranged in the nests (78, 78a).

8. The apparatus according to claim 1, characterized in that the arm (50) is mounted on a carriage (46) which is held on a carrier element (38) having a linear guide (44) so as to be guided vertically and that the carrier element (38) is rotatably supported on the machine frame (10, 28).

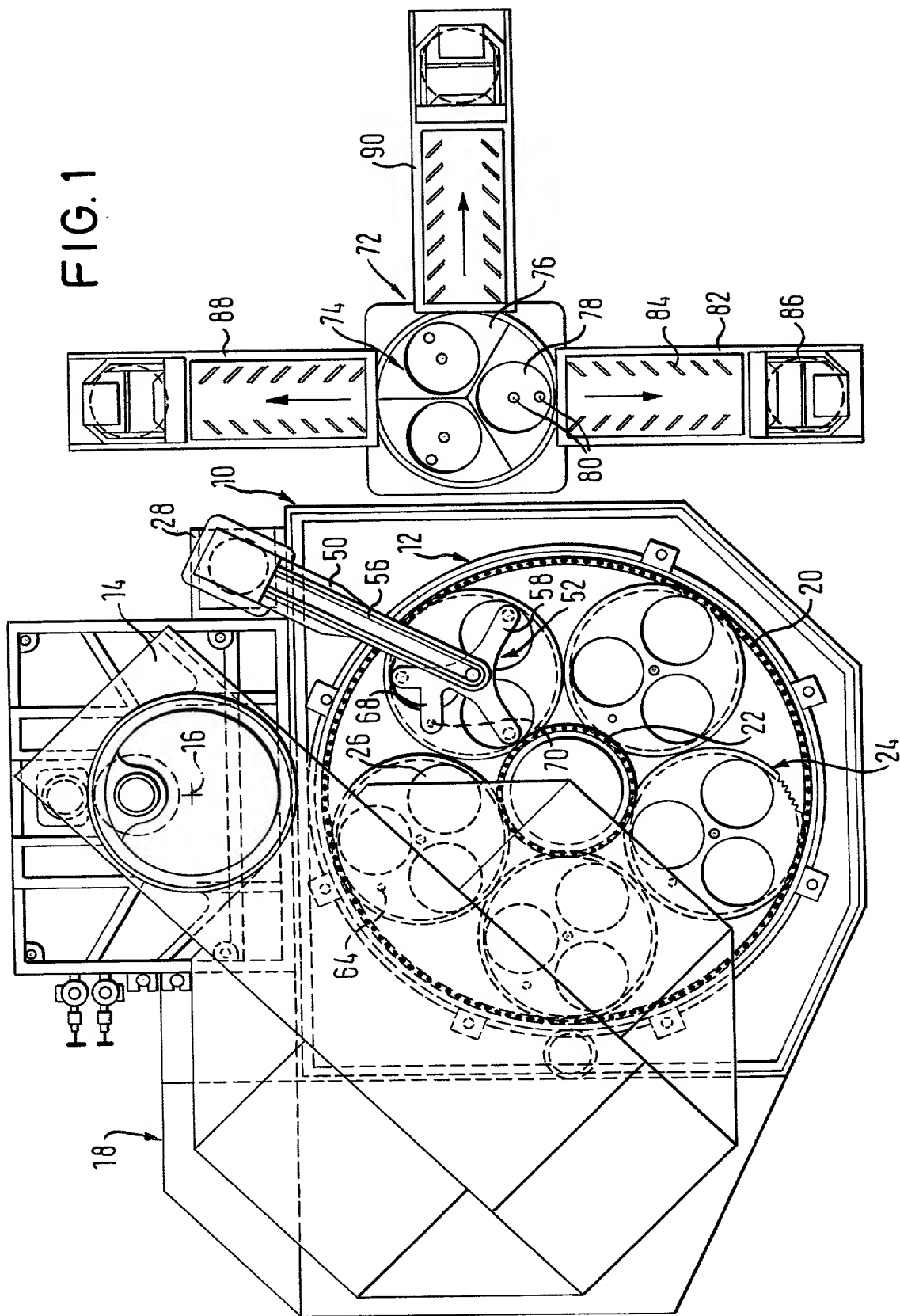
9. The apparatus according to claim 1, characterized in that the arm (50) is pivotally supported about a vertical axis on a bearing component (28a) and is driven by a swivel drive and that the bearing component (28a) is movably supported along a linear guide (100) which is arranged between the polishing machine and a second polishing machine and that the bearing component (28a) is adapted to be displaced by an actuator drive along the guide (100).

10. The apparatus according to claim 9, characterized in that the upper polishing disks of the two polishing machines are pivotally supported about a vertical axis towards opposed sides.

## ABSTRACT OF THE DISCLOSURE

### **APPARATUS FOR REMOVING SEMICONDUCTOR WAFERS FROM WITHIN THE RUNNER DISKS OF A DOUBLE-SIDED POLISHING MACHINE**

An apparatus for removing semiconductor wafers from within the runner disks in a double-sided polishing machine. The apparatus includes a suction head adapted to be connected to a vacuum, which has a plurality of suction ports such that all semiconductor wafers received by a runner disk may be gripped simultaneously. The apparatus also includes an arm on which the suction head is rotatably supported about a vertical axis and which, in turn, is pivotally supported about a vertical axis at a spacing from the suction head or is supported so as to be linearly adjustable or adjustable in height. The apparatus also includes a rotary drive for the suction head, a drive for the arm, a lifting drive for the arm, and a control device for activating the drives such that the semiconductor wafers may be deposited on a lay-down device in a predetermined, aligned position.



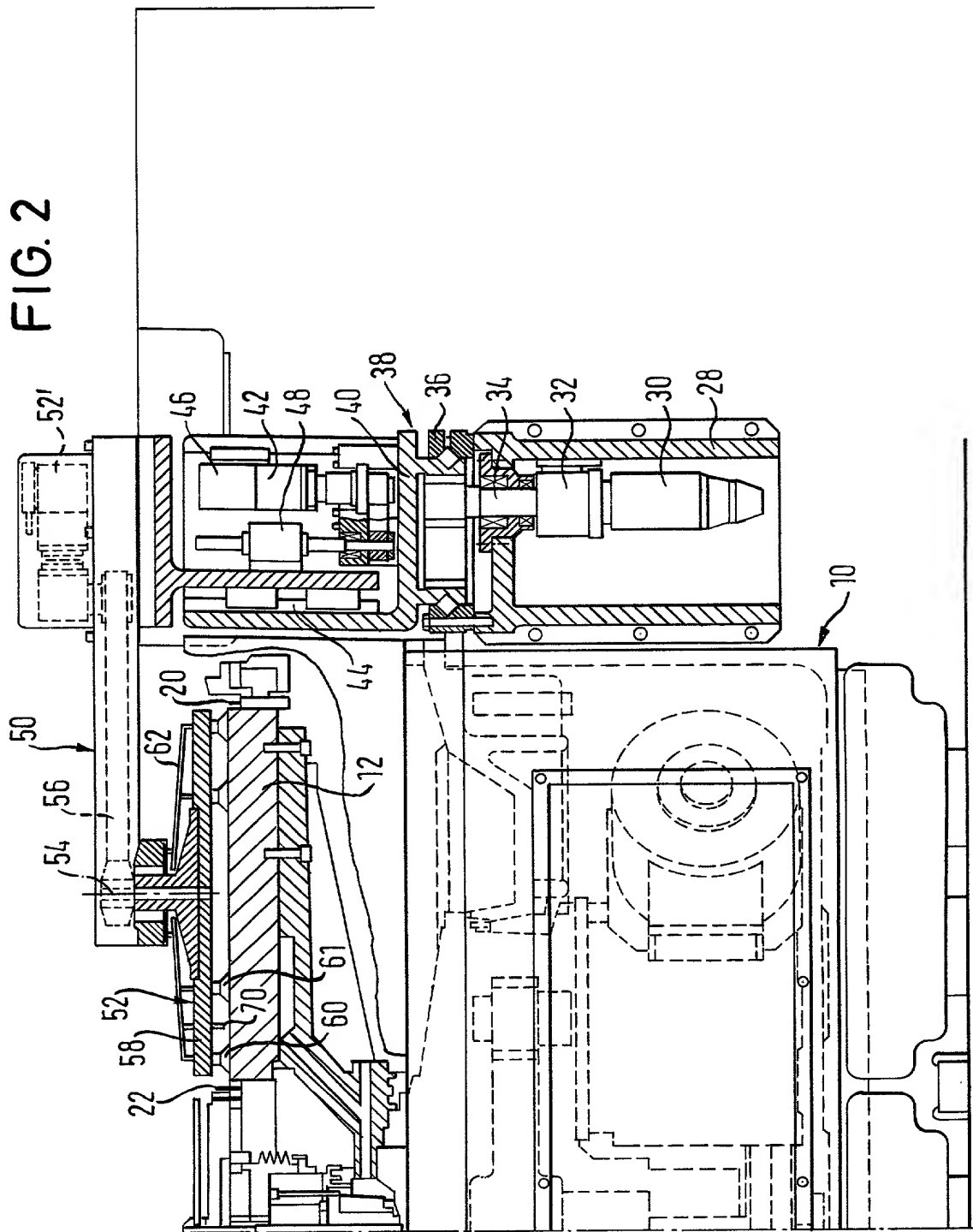
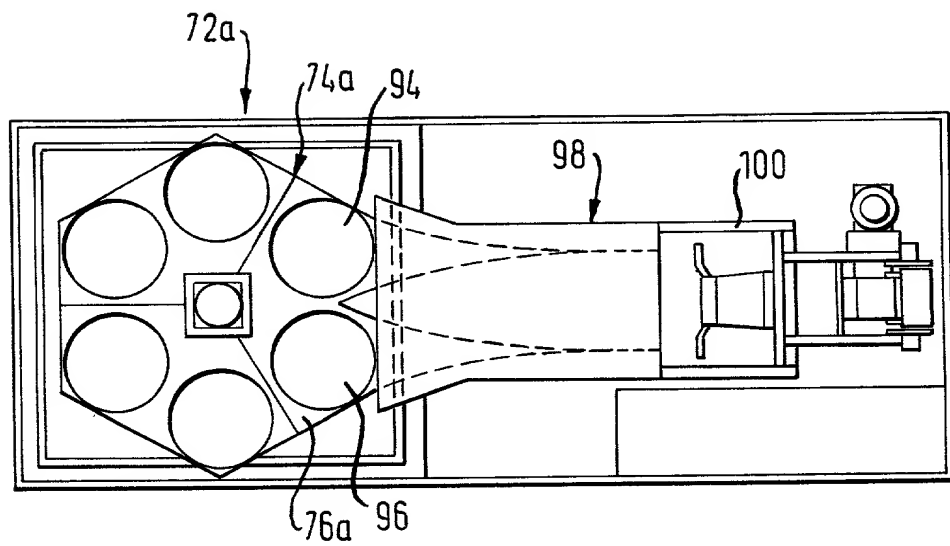


FIG. 3





## DECLARATION

As a below-named inventor, I(we) hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name;

I verily believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

APPARATUS FOR REMOVING SEMICONDUCTOR WAFERS FROM WITHIN THE RUNNER  
DISKS OF A DOUBLE-SIDED POLISHING MACHINE

*(Insert invention title)*

the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to in the declaration.

I acknowledge the duty to disclose all information which is known to be material to patentability of this application in accordance with Title 37, Code of Federal Regulations § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119, of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

*(List prior foreign applications)*

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
Germany	199 53 004.1	29 / 10 / 1999	[X] YES NO [ ]
Germany	100 07 389.1	18 / 02 / 2000	[X] YES NO [ ]
			[ ] YES NO [ ]

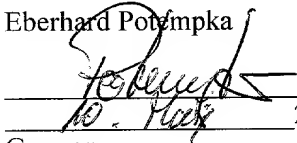
I hereby declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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(Attach additional sheets for third and subsequent inventors)



## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor: Eberhard Potempka )  
 Title APPARATUS FOR REMOVING SEMICONDUCTOR )  
 WAFERS FROM WITHIN THE RUNNER DISKS OF )  
 A DOUBLE-SIDED POLISHING MACHINE )  
 Filed: [X] Concurrently Herewith )  
 [ ] on \_\_\_\_\_ )  
 Ser. No. \_\_\_\_\_ )

POWER OF ATTORNEY  
FROM ASSIGNEE

Box PATENT APPLICATION  
 Assistant Commissioner for Patents  
 Washington, DC 20231

Docket No: 401.2-9276

Peter Wolters Werkzeugmaschinen GmbH  
 (Name of Company)

, as assignee of

the entire interest of the above identified patent application, hereby appoints the following attorneys to insert the docket no., filing date and application number of said application above when known; to prosecute this application and any application claiming priority therefrom; to execute any terminal disclaimers on behalf of assignee; and to transact all business in the Patent and Trademark Office connected therewith:

Oliver F. Arrett	Reg. No. 22,117
Scott Q. Vidas	Reg. No. 30,812
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Jane H. Arrett	Reg. No. 33,355
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all of VIDAS, ARRETT & STEINKRAUS, Professional Association, Suite 2000, 6109 Blue Circle Drive, Minnetonka, Minnesota 55343, USA, Telephone (612) 563 3000, and I hereby authorize them to act and rely on instructions from, and to communicate directly with, the firm or person which sent this case to VIDAS, ARRETT & STEINKRAUS unless or until I instruct VIDAS, ARRETT & STEINKRAUS in writing to the contrary.

Dated this 10 day of May, 2000

(Name of Company)

Peter Wolters Werkzeugmaschinen GmbH

(Signature)

By: Dr. Carl-Ulrich Bauer  
 Dr. Carl-Ulrich Bauer  
 Its: Managing Director

(Title)

(Filing date, serial number and docket number may be left blank at time of signing)

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**PATENT**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

<b>In re Application of:</b>	Eberhard POETMPKA
<b>Application No.:</b>	<i>(Not yet assigned)</i>
<b>Filed:</b>	<i>(Concurrently herewith)</i>
<b>For:</b>	APPARATUS FOR REMOVING SEMICONDUCTOR WAGERS FROM WITHIN THE RUNNER DISKS OF A DOUBLE-SIDED POLISHING MACHINE
<b>Examiner:</b>	<i>(Not yet assigned)</i>
<b>Group Art Unit:</b>	<i>(Not yet assigned)</i>

Box Patent Application  
Assistant Commissioner for Patents  
Washington, D.C. 20231

Docket No.: H01.2-9276

**CORRESPONDENCE ADDRESS OF LAW FIRM**

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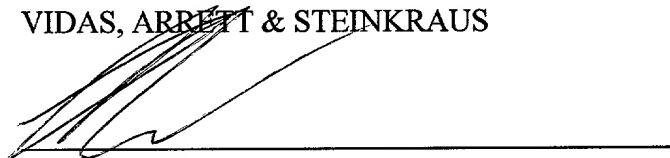
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